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ECOLOGICAL SEGREGATION[1]

By Professor A. S. PEARSE

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ANIMALS known to science all live in a thin layer which is close to the surface of the earth. The complex group of conditions which surround any animal is called an environment. An area where more or less uniform conditions obtain is a habitat. Animals are in a general way adapted to live in particular habitats in one of the three great ecological realms—sea, fresh water or land. This statement raises the first question: What is adaptation and how does it come about?

ADAPTATION

To most zoologists adaptation means merely that an animal fits its particular environment. A fish out of water does not fit; an eagle is out of place in the depths of the ocean. Somewhere on the earth there is a place where an animal fits in a more or less precise way. It is impossible to conceive an animal without its environment. If an animal does not fit, it ceases to exist. If an animal continues to exist it must perhaps change its habitat and its bodily constitution somewhat as earth environments change. "Evolution is no more than adaptation of organisms to environment."[2] The past history of the earth indicates that unusual environmental conditions precede new types of adaptation in animals.[3] Animals must in a changing environment remain continually adapted or become extinct.

If one studies in detail the adaptations of animals

[1] Address before Section F—Zoological Sciences, American Association for the Advancement of Science, Boston, December 28, 1933.

[2] S. L. Hora, "Ecology, Binomics and Evolution of the Torrential Fauna, with Special Reference to the Organs of Attachment," *Philosoph. T. Roy. Soc.*, London (B), 218: 171–282, 1930.

[3] H. F. Osborn, "The Origin and Evolution of Life," xxi + 332 pp., New York, 1917.

to environment, he is often surprised at the degree of accuracy with which many of them fit particular habitats. Along the shores of the coral islands at Dry Tortugas there are four species of hermit crabs and each is adapted to life in a particular stratum.[4] A gigantic species which lives at depths of from one to sixty fathoms has 26 gills; another rather small species that lives in a zone about one meter thick just below the tide mark also has 26 gills; a minute species that lives at high-tide mark, exposed to winds and tropical sun, has 18 gills, and the common land hermit crab has but 14 gills. The littoral crabs at Tortugas and along the coast of Carolina[5] are also assorted into rather definite zones and are correspondingly adapted. They form a graded series in regard to the size of their gills. In those that live always below low-tide mark and never leave the ocean the volume of the body is about twenty times that of the gills, but, as habitats and crabs progress upward through the tidal zone, gills dwindle. Above high-tide mark, where certain species of crabs have become terrestrial, the body may have 60 times the volume of the gills. On the coast of Japan[6] and at Tortugas the salinity of the blood of crabs decreases from the ocean through various zones toward land. Species which are adjusted to life on land have less salt in their blood than those which have remained in the ocean, and vary less with changes in the surrounding medium.

At the mouth of the Menam in Siam there are three species of gobioid fishes which live together on the muddy beaches.[7] They do not occupy horizontal zones but skip about together when the tide is out, hunting for food. On examination the largest goby was found to subsist chiefly on fishes and crabs, and the length of its intestine averaged about two thirds that of its body; the goby of medium size had an intestine nearly three times as long as its body and ate little but algae; the small goby fed mostly on insects and had an intestine shorter than its body. The parasites of the gobies were also quite distinct and characteristic. Though the three species of gobies were occupying the same area, each was adjusted quite differently to the environment.

Animals tend to become specialists in their relations with environment. There are bees which find food in only one species of flower, during a limited season of the year, and only during certain hours of the day; there are ants which starve unless they can feed on one species of fungus; there are parasites which can exist in only one species of host. A particular species of animal to obtain food may be adapted structurally, physiologically, psychologically, biographically or numerically,[8] but all tend to become adapted to particular conditions as they exist on the earth.

Though animals generally tend to become specialists, there are those at each period of earth development which remain generalized to some extent. An animal as an individual begins life with a certain group of adaptations which fit it for a particular habitat. It may inherit characters which are of no apparent value in its adaptation to environment—Sumner[9] says that useless characters are common, and that such are often used by taxonomists to distinguish species. Elton[10] maintains that closely related species do not differ in adaptive characters. Probably no one believes that all characters are adaptive at all times. Races of particular species which appear to be well adapted to peculiar environments will in some cases maintain their characteristics when transferred to new and different environments.[11] Their adaptations have in some way become bred into the race. Ecologists well know that in nature versatile species are generally more abundant than narrowly specialized species. Specialists are not dominant in any particular habitat, but those having intermediate degrees of specialization and wider ranges of toleration to varying environmental factors often are.[8] Recent discoveries in the field of genetics, though they extend knowledge of how hereditary characters are transmitted, do not explain adaptation.[12] It has long been known that a maladapted species may continue to live in an environment which is not overpopulated, but, when such a species competes with others, which are particularly adapted to that environment it is the first to be exterminated.[13] Lull[14] states that adaptation results largely from competition.

[4] A. S. Pearse, "Observations on Certain Littoral and Terrestrial Animals at Tortugas, Florida, with Special Reference to Migrations from Marine to Terrestrial Habitats," Pap. Tortugas Sta., Carnegie Inst. Washington, 391: 205–223, 1929.

[5] A. S. Pearse, "The Ecology of Certain Estuarine Crabs at Beaufort, N. C.," *J. Elisha Mitch. Soc.*, 44: 230–237, 1929a.

[6] A. S. Pearse, "Freezing Points of Bloods of Certain Littoral and Estuarine Animals," Carnegie Inst. Washington Publ., 435: 93–102, 1932.

[7] A. S. Pearse, "The Gobies at Paknam," *Jour. Siamese Nat. Hist. Soc.*, 1933 (in press).

[8] A. G. Vestal, "Internal Relations of Terrestrial Associations," *Amer. Nat.*, 48: 413–445, 1914.

[9] F. B. Sumner, "Is Evolution a Continuous or a Discontinuous Process?" *Sci. Mo.*, 29: 72–78, 1929.

[10] C. Elton, "Periodic Fluctuations in the Numbers of Animals: Their Causes and Effects," *Brit. Jour. Exper. Biol.*, 2: 119–163, 1924.

[11] F. B. Sumner, "The Analysis of a Concrete Case of Intergradation between Two Subspecies," *P. Nat. Acad. Sci.*, 15: 110–120, 481–493, 1929a.

[12] M. Caullery, "Present Theories of Evolution and the Problem of Adaptation," 1–19, Philadelphia, 1933.

[13] E. Warming, "Oecology of Plants," xi + 422 pp., Oxford, 1909.

[14] R. S. Lull, "Organic Evolution," xix + 743 pp., New York, 1929.

COMPETITION

As species animals in their relations with each other may be more or less social, indifferent or antagonistic. Men conserve and increase cattle; squirrels and rabbits occupy the same areas without interfering with each other; brown rats have been known to fight and exterminate black rats under certain conditions. Darwin[15] looked upon competition as a natural phenomenon which checked the unlimited increase of animals—each species struggles to increase and is kept down by competition with others. Lull[14] says that competition is inseparable from life and leads to adaptations and complex interrelationships. Osborn[3] states that competition and selection test all actions, reactions and interactions in nature. Warming[13] asserts that competition produces new species.

Robertson[16] believes that competing species are often not closely related. Borradaile[17] maintains that the individuals of a single species do not compete, but that communities may do so. There is perhaps some doubt about this, but Borradaile makes another point that appears to be a very good one: *i.e.*, that competition may be suspended for a time when a species invades new territory and food is then temporarily plentiful and enemies few. Vestal[8] has listed five types of characters which may be adapted so as to remove animals from competition: (1) structural, which may give animals special advantages in particular habitats (legs of mole); (2) physiological, such as ability to digest and assimilate unusual foods (clothes moth eats keratin) or to exist in peculiar environments (anaerobic animals); (3) psychological, such as preferences for special foods or habitats; (4) biographical, which permit adaptation of life cycles to favorable seasons, feeding to particular times of day, etc., and (5) numerical, by which the numbers of a species produced by reproduction are adjusted to food supply or other limiting environmental factors. Noble[18] has pointed out that species of plethodontid salamanders are most sharply segregated at the time of breeding. They avoid competition by selecting different humidities, types of streams, and other particular qualities in their environments.

Populations which result from competition in particular habitats are subject to D'Ancona's laws:[19] (1) periodic cycle, (2) conservation of averages, and (3) disturbance of averages. "The fluctuations of two species are periodic; and the period depends solely upon the coefficients of increase and decrease, and initial conditions. . . . The averages of the number of individuals of two species are constant whatever may be the initial values of the numbers of individuals of two species, just so long as the coefficient of increase and decrease of the two species and that of protection and offence remain constant. . . . If an attempt is made to destroy the individuals of two species uniformly and in proportion to their numbers the average of the number of species that is eaten increases and that of the individuals feeding upon the other diminishes." Chapman has used two useful descriptive terms: "biotic potential" which refers to the ability of a species as a result of all its activities to produce offspring, and "environmental resistance," the obstacles to be overcome in populating a particular habitat. The dominance of an area by a particular species means more than mere survival. "Dominance in a species, then, would seem to include the dependence of other animals upon it, plus the ability to thrive in spite of the drain upon its numbers. . . . Dominant animals appear to be those of moderately specialized habits, rather than those of highly specialized, or relatively unspecialized habits. . . . Species which are relatively free from competition or which have comparatively few enemies may be successful, but are not dominant, and are usually not numerous."[8] Most students of competition seem to have had their minds fixed upon the struggle for existence among animals and little thought has been given to the fact that adaptation so often results in permitting animals to avoid competition.

HABITATS

The environment must furnish all that animals need to maintain their systems of activities: food, shelter, freedom from competition, opportunity for reproduction. In an area where there is a variety of habitats there will be varied and numerous species; where environment is monotonous and limited there will be few species. Animals commonly seek out habitats which are as near their optimum conditions as a particular environment offers. Where there are transitions from one type of habitat to another species are often arranged in more or less definite zones, as along a seashore or the margin of a forest. Many animals establish homes at particular spots which are apparently no better than hundreds of others, but once selected, are retained with great tenacity. Pond turtles are rather sedentary animals and seldom move a hundred yards during a year; many sea birds return year after year to particular rookeries, even when conditions have become unfavorable; the hom-

[15] C. Darwin, "On the Origin of Species by Means of Natural Selection," xxi+458 pp., 6th ed., New York, 1875.

[16] C. Robertson, "Ecological Adaptation and Ecological Selection," SCIENCE, 23: 307–310, 1906.

[17] L. A. Borradaile, "The Animal and Its Environment," vii+399 pp., London, 1923.

[18] G. K. Noble, "The Plethodontid Salamanders; Some Aspects of Their Evolution," *Am. Mus. Nov.*, 249: 1–26, 1927.

[19] R. N. Chapman, "Animal Ecology with Especial Reference to Insects," x+464 pp., New York, 1931.

ing behavior of pigeons, terns, crabs and snails is well known. A bird may select a particular roosting place in a tree and return to it again and again, not because the particular spot is the best that can be found, but perhaps because it has proved to be satisfactory and its use saves the labor of seeking each day for a suitable situation. There is a very widespread tendency among animals to choose suitable and often particular situations in the environment.

"The common belief that allied species occur in separate habitats is by no means true."[20] Many closely related varieties of mammals occupy separate areas; races of mollusks and insects often live on areas that overlap and related varieties frequently occur together.

In any habitat there is some degree of environmental resistance to population. At Tortugas certain species of sponges serve as living hotels for hundreds of commensals and parasites; other species which are of about the same size and structure contain few or none. Some species of sponges are apparently more favorable habitats for animals than others. There are many cases of an extreme degree of adaptation in the host specificity of parasites. Many bird lice are restricted to a single host species. Other nearly related hosts are not favorable environments. Biotic potential in any habitat must overcome environmental resistance. Elton[21] has pointed out some very good illustrations of the control of animal populations by variations in climate, food and other factors. He cites certain owls, gulls and other animals which rear larger broods or breed only in "lemming years," when an abundance of food is available.

A habitat is the salvation or the destruction of an animal. Variations continually take place in both environment and organism. If either varies beyond the limits of toleration of the other, the organism must migrate to a more favorable environment, adjust its system of activities to new ranges of toleration, or die.

SEGREGATION

Segregation is a familiar phenomenon in biology. Crystals, colloids, genes, sexes, races, species, communities and other systems of activities segregate. They thus attain more or less individuality and independence from other systems and in some cases are thus perhaps better adapted to existing environments. In considering why segregations take place one is confronted with several possibilities. No animal, except among lowly asexual types, can live wholly alone, and many animals are adapted to more or less complex communal relations. Some substances, like oil and water, will not mix and when forcibly brought together separate again. Some qualities of living organisms, such perhaps as those which are concerned with sterility and lethal factors, are perhaps incompatible in somewhat the same way. Quite another aspect of segregation is shown by such tendencies as those which gradually lead to the formation of subspecies and species. It is possible that orthogenetic variation may produce new races and species without the influence of environment, except that variants must always fit well enough to survive. Assortative mating may segregate groups within a species and thus lead to the formation of new races or species.

There have been many adherents of the view that geographic isolation is essential for the formation of ecologically different groups. Jordan[22] pointed out that two subspecies seldom occupy the same area. During a careful survey of the distribution of the marine animals at Woods Hole, Massachusetts, Sumner, Cole, and Osburn[23] supported this view. They found that the ranges of subspecies and even species in the same genus often overlapped but were never identical. Such observations suggest that the requirements or ranges of toleration may be different in two such groups of animals. Yet Goldschmidt[24] says, "there is in my opinion no reliable fact known which would force us to assume that geographic variation or formation of subspecies has anything to do with speciation; the results of genetical analysis and of sober evaluation of other facts are positively in contradiction to such an assumption." Sumner[25] takes the position that the boundaries between subspecies of mice of the genus *Peromyscus* are geographical rather than morphological. The local distribution of any animal community, especially on land, depends on the extent of the physical environment to which it is adapted and more or less directly on the local distribution of plants which furnish food and shelter. In Florida Sumner[25] found a rather sharp boundary between two subspecies of mice. One lived on the light-colored sands near the coast and was pale; the other was found inland and was dark in color. Over a narrow strip two or three miles wide there were some intergradations between the two subspecies.

It has been suggested often that segregation, not

[20] O. W. Richards and G. C. Robson, "The Species Problem and Evolution," *Nature*, 117; 345–347, 382–384, 1926.

[21] C. Elton, "Animal Ecology," xx + 207 pp., N. Y., 1927.

[22] D. S. Jordan, "The Origin of Species through Isolation," SCIENCE, 22: 545–562, 1905.

[23] R. C. Osburn and L. J. Cole, "A Biological Survey of the Waters of Woods Hole and Vicinity, I, Physical and Zoological," *Bull. U. S. Bur. Fisheries*, 31: 1–442, 1913.

[24] R. Goldschmidt, "Some Aspects of Evolution," SCIENCE, 78: 539–547, 1933.

[25] F. B. Sumner, "Genetic, Distributional and Evolutionary Studies of the Subspecies of Deer Mice (*Peromyscus*)," *Bibliogr. Genet.*, 9: 1–106, 1932.

necessarily in the nature of geographic isolation, is necessary to maintain a species or a variety. Many biologists hold the belief that a new species has its inception when a group of animals or plants forms a community with a new or a restricted environment.[26, 2] Regan has stressed what he calls habitudinal segregation as a primary factor in the origin of races and species. Robertson[16] maintains that specific characters are the result rather than the cause of such segregation. He points out that various species of bees of the genus Colletes fly out to search for food at different times of the day and at different seasons of the year. Though their structures for collecting pollen and nectar are quite similar, they do not subsist on the same foods. Again the tendency of organisms to become specialized to particular environmental conditions is apparent. One group of animals may be deterred from association with another by habitat preferences, peculiar odors, the structure of copulatory organs, assortative mating, and countless other qualities, as well as by geographic or genetic isolation.

Environment and Species

An organism can never reach a condition of complete stability. It undergoes rhythmical and progressive internal changes and makes adjustments to changes outside itself. It must live continually in a changing environment. With a given range of hereditary qualities which make it fit into a particular niche in nature it must struggle to survive and produce offspring. There seems to be no doubt that new species have evolved from previously existing species in the past and that they are doing so at the present time. There are three views generally held in regard to the relation of environment to such changes in the constitution of the living systems of activities known as species: (1) the changes are brought about by causes wholly within the organism itself—they are automatic; (2) the germ cells are changed by external causes, and (3) the soma is changed by environment and in turn influences the germ. Those who think chiefly about adaptation often lean toward the last explanation; those who accumulate evidence by breeding and genetic experiment perhaps most often adhere to the first. At present there appears to be no evidence to decide which of these views is correct. All that can be done is to continue to accumulate evidence until there is enough to prove something. The logical thing to do then is to review the limited group of facts that scientific investigation has accumulated, and go to work. The writer will attempt to discuss some of the known facts which ecologists believe may be related to the origin of species.

[26] C. T. Regan, "Mendelism and Evolution," *Nature*, 113: 569, 1924.

It is probable that mutations and natural selection operate to produce new species. Genes which can be demonstrated by crossing over are concerned with the inheritance of varietal, or racial, significance only.[27] Specific characters which are transmitted as hereditary qualities may be useful for survival, but often they apparently are not.[20] All diversity is not the result of selection based on utility.[11] Secondary sex characters are often used by taxonomists as a basis for separating species. Their evolution is "usually not progressive and continuous but haphazard and often parallel in not closely related stocks."[18] A new species probably never arises as the result of one mutation. Changes which lead to the production of new species apparently may be continuous, gradual and adaptive,[26] discontinuous and non-adaptive, or slow and non-adaptive.[20]

As has been pointed out, there is a wide-spread belief among ecologists that animals that take on new habits and habitats initiate new species.[16, 26, 20, 2] New races often originate on areas which are more or less remote from those occupied by the parent stock.[25] Specific characters are probably the result rather than the cause of segregation.[20] New races of mammals appear to arise where optimum environmental conditions alternate with unfavorable conditions.[10, 25] When environmental conditions are close to the optimum for a species an area becomes thickly (perhaps over) populated and variants which have non-adaptive characters may become established. When an area becomes overpopulated epidemics are more likely to occur and predacious enemies increase. The population is then greatly reduced and a small group of peculiarly adapted survivors may remain. When lemmings are abundant in Northern Europe ptarmigans are not often eaten by foxes and owls and may increase in numbers, but after a great migration and epidemic among lemmings ptarmigans are preyed upon and in turn decrease. Thus successive periods of overpopulation, epidemic and survival may result in the evolution of a new species; a heritable variation is left in a small group of animals after depopulation.[10]

A species is a complex of characteristic but more or less variable structures, functions, instincts, habits and other qualities. Fulton[28] recently separated three races of the cricket, *Nemobius fasciatus*, chiefly because they have different songs. These races "are more distinct physiologically than morphologically," but "they seldom if ever interbreed under natural conditions." When a species is in the making it is

[27] L. Plate, Vererbungslehre, mit besonderer Berucksichtung der Abstammungslehre und des Menschen. I. Mendelismus, x + 554 pp., Jena, 1932.

[28] B. B. Fulton, "Inheritance of Song in Hybrids of Two Subspecies of *Nemobius fasciatus (Orthoptera)*." *Ann. Entomol. Soc. Amer.*, 26; 368–376, 1933.

not certain whether changes in such qualities as structures or habits, assortative matings or interracial sterilities come first. No one knows whether a group of animals by living in a new habitat gradually acquires new structures or whether animals with peculiar structures are especially fitted from the beginning to live in different habitats than those occupied by the parent stock.

Available knowledge shows that there has been evolution. The mechanisms of heredity are quite well known. The great biological mystery to-day is variation. About all that scientists at the present time are able to do is point out the conditions under which animals vary. So there are well-understood examples of hybridization, the establishment of pure lines, the changing of the phylogenetic record as represented during ontogeny by acceleration and larval adaptation, even the modification of gene characters by experimentally controlled environmental factors; but why animals vary no one knows.

When factors which have played a leading rôle in the formation of species are considered, an ecologist thinks first of environment. Present-day evidence does not indicate that environment has caused animals to vary. It does suggest that new species have arisen by segregation—structural, physiological, reproductive, genetic, habitatic and biographical. Ecological segregation is one factor which has been associated with the production of new species, which are perhaps at times produced by competitive, struggling selection and at times by groups of animals which by becoming adapted to peculiar and previously unoccupied niches in environment are able to escape competition. *Quien sabe?*

TISSUE REACTIONS IN IMMUNITY: XIV. THE SPECIFIC REACTING CAPACITIES OF DIFFERENT TISSUES OF AN IMMUNIZED ANIMAL[1,2]

By Dr. REUBEN L. KAHN

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THE protective forces of a bacterial-immunized animal, according to modern immunologic knowledge, are centered largely in the fluids and the wandering cells. The great controversy of half a century ago regarding the humoral and cellular theories of immunity is at present of historical interest only; it is now generally accepted that humoral antibodies as well as phagocytes are lined up in defense of the host when attacked by bacteria. Although bacterial attacks generally involve fixed tissues, such as the skin, muscle, etc., yet the rôle of these tissues in immunity is far from established. Indeed, these tissues are regarded as hypersensitive to the very organisms against which the protective forces of the fluids and phagocytes are directed.

Let us consider two basic and readily measurable responses of a rabbit immunized with a protein solution or a bacterial suspension, namely, the reaction between serum and antigen and the reaction between skin and antigen. The former is classed under the familiar antigen-antibody reactions, while the latter is referred to as local anaphylaxis, tissue hypersusceptibility or hypersensitiveness. The basis for the latter terminology is the fact that specific antigen injected into the skin of an immunized rabbit calls forth an inflammatory response not given by a normal rabbit. It is this inflammatory response that is interpreted to be the result of a specific hypersusceptible state of the skin.

In spite of this interpretation of skin hypersusceptibility to the antigen, it is not generally assumed that the skin actually enters into a union with the antigen in producing the inflammatory reaction. The view is prevalent that the inflammation is due to an interaction between circulating antibodies and the introduced antigen, that this interaction results in substances toxic to the tissues, thus causing the inflammatory response. If this view is accepted, it would appear that the tissue in which the specific inflammation occurs is merely a "neutral bystander" in a reaction that takes place between an antigen and antibody.

The experimental data to be herewith considered

[1] This paper contains an account of the work by Dr. Kahn for which the eleventh annual award of the American Association for the Advancement of Science was made at the Boston meeting.

[2] For previous publications in this field, the reader is referred to: R. L. Kahn, "Skin Response as a Measure of Immunization and Sensitization," *Jour. Bacter.*, 25: 81, January, 1933; "Studies on Sensitization," Papers I to VI, *Proceed. Soc. Exp. Biol. and Med.*, 30: 603, March, 1933; "Studies on Tissue Reactions in Immunity," Papers VII to XIII, *Jour. Immunol.*, 25: 295, October, 1933. Papers XV and XVI, in press, give detailed experimental data of the present article.

question the fitness of the terms "local anaphylaxis" or "tissue hypersensitiveness" when applied to tissue-antigen reactions in an immunized rabbit, and do not confirm the view that these reactions are the result of the union between antigen and circulating antibodies. The data indicate that tissue-antigen reactions belong in the same class with serum-antigen reactions; that both reactions are manifestations of a property acquired in common by the tissues, fixed as well as fluid, as a result of immunization; namely, the property to combine with antigen. The data further indicate that this capacity to combine with antigen differs quantitatively with different tissues, some possessing the capacity to a greater degree than others.

EXPERIMENTAL

Specific Tissue Reactions of an Immunized Animal are Independent of Serum Antibodies

We shall first attempt to answer the question as to whether or not the tissue-antigen reaction of a protein-immunized animal is dependent upon circulating antibodies. Elsewhere we have described a simple method whereby a comparison of the capacities of the skin and of the serum to react with antigen can be established in a protein-immunized rabbit by determining simultaneously the skin-reacting and serum-precipitin titers. The method is carried out as follows: An albino rabbit is immunized by means of one or more injections of a protein solution, such as human serum. At the time set for determining the precipitin and skin reactions, a series of dilutions of this serum with physiologic salt solution is prepared so as to have undiluted serum and a 1:10, 1:100, 1:1000, 1:10,000, and 1:100,000 dilution. For precipitin tests, 0.1 cc quantities of these dilutions are mixed with 0.1 cc amounts of undiluted immune rabbit serum and the mixtures incubated for 1 hour at 37° C., followed by about 18 hours at icebox temperature. The highest dilution of human serum giving a precipitate with the rabbit serum is considered the precipitin titer. For skin tests, 0.1 cc quantities of the same dilutions of human serum are injected into the hair-clipped skin of the immune rabbit. The injections are given about 2 inches apart on one side of the animal and the reactions are noted after 24 hours. The highest dilution of the human serum producing an inflammatory response is considered as the skin-reacting titer.

If a rabbit is immunized with a very small amount of human serum such as one injection of 0.1 cc of a 1:10 dilution with physiologic salt solution, it will be found that, in about two weeks, the serum-precipitin titer may reach 1,000, while the skin-reacting titer may be somewhat lower. In the course of a month, however, the serum-precipitin titer will probably become negative, while the skin-reacting titer may be as high as 1,000, *i.e.,* 0.1 cc of 1:1,000 dilution of serum causing the production of an inflammatory response. With immunizing injections of larger quantities of serum, the presence of the precipitins will be prolonged, but on their disappearance, the skin-reacting titer has invariably been found to be relatively high. The result of this experiment indicates that the skin-antigen reaction is not dependent upon serum precipitins, also that the skin reaction is a more permanent response than the serum reaction.

Let us now turn to an experiment wherein skin and serum reactions were simultaneously determined in bacterial-immunized rabbits. Two groups of rabbits were chosen. One group was immunized by repeated injections of killed typhoid suspensions, given intracutaneously, and the second group by similar injections administered intravenously. From time to time the serum-agglutinin and skin-reacting titers were determined simultaneously. The former titer was established in the usual way. In determining the skin titer, a series of bacterial suspensions was prepared, in multiples of 10, ranging from 1,000,000,000 to 100,000 or 10,000 organisms per cubic centimeter, and intracutaneous injections of 0.1 cc quantities of these suspensions were given as in the case of the serum dilutions in the previous experiments. The least number of organisms in a suspension producing an inflammatory response in the skin 24 hours after the injection represented the skin-reacting titer to the organisms.

Judging from the results of this experiment, no direct relation exists between the serum-agglutinin titer and skin-reacting titer to the bacterial suspension. It was found that the rabbits immunized by cutaneous injection showed a high skin titer and a low agglutinin titer, while the rabbits immunized by intravenous injection showed a high agglutinin titer and a low skin titer. If the skin reactions were dependent upon serum agglutinins the two types of titers would tend to parallel one another. It would appear, therefore, that so far as the skin reaction is concerned, the bacterial-immunized rabbit does not differ from the protein-immunized animal; that in both cases the tissue reaction is independent of serum antibodies.

Tissues of an Animal Undergo a Definite Change as a Result of Immunization

Thus far, the experiments cited have demonstrated changes in the skin of rabbits as a result of immunization. The following experiment will demonstrate similar changes in other tissues. The experimental plan utilizes horse serum as the immunizing agent and diphtheria toxin with its specific horse-serum antitoxin as the agents for establishing that the

various tissues of the rabbit have undergone a definite change as a result of the immunization with horse serum. Thus, if a given dose of diphtheria toxin, such as 50 MLD, is injected intracutaneously in a normal rabbit and simultaneously a liberal dose of horse-serum antitoxin, such as 50 units, is injected in another area in the skin, the animal will show little effect from the injected toxin. If, however, the same quantities of toxin and antitoxin are injected under the same conditions in a rabbit immune to horse serum, the animal will be found to succumb to the toxin. The antitoxin, being part of horse serum, apparently enters into some union with the skin and is thereby prevented from diffusing into the tissues where it could meet and neutralize the toxin.

Let us consider a more comprehensive experiment. Six groups of horse-serum-immunized rabbits were injected intracutaneously with 50 MLD toxin. Each animal was then immediately injected with 50 units of antitoxin—group 1, intracutaneously; group 2, subcutaneously; group 3, intraperitoneally; group 4, intravenously; group 5, intramuscularly; and group 6, intracerebrally. All the animals, without exception, succumbed to the toxin. Non-immunized as well as human-serum-immunized control rabbits that received similar toxin and antitoxin injections survived without exception.

It is evident from the results of this experiment that different tissues, fixed as well as fluid, of a protein-immunized rabbit undergo a definite change as a result of immunization. This change apparently is of such character as to cause these tissues to combine with the injected antigen and prevent its diffusion into the surrounding tissues.

Tissues of an Immunized Animal Possess Different Capacities for Reacting with Antigen

The problem arose as to whether it might be possible to measure in horse-serum-immunized rabbits the extent of the union of different tissues with horse-serum antitoxin. If this were possible, we would have a measure of the antigen-combining capacity of the different tissues of an immunized animal, which in turn would indicate the extent of the immunity of the different tissues. The following approach suggested itself: to inject a standard dose of diphtheria toxin, such as 50 MLD, in a group of rabbits similarly immunized with horse serum and to determine the number of units of antitoxin, when injected by different routes, that will save these animals from toxin death. If, for example, they should be saved by the same number of units, whether injected intracutaneously or intramuscularly, one would assume that these two tissues have the same combining capacity for antitoxin. If, however, a widely different number of units would be required to save the rabbits, depending on the route of injection, then it would be necessary to assume that these two tissues possess different combining capacities for the antitoxin.

An experiment of this nature was carried out wherein the antitoxin was injected not only intracutaneously in one group and intramuscularly in another, but also subcutaneously, intraperitoneally, intravenously and intracranially in four corresponding groups. It was found that in order to save these horse-serum-immunized rabbits from death from the 50 MLD toxin: 1,500 units of antitoxin were necessary, when injected intracutaneously; 1,000 units, when injected either subcutaneously or intraperitoneally; 100 units, when injected intramuscularly or intracerebrally; and 75 units, when injected intravenously. The administration of less antitoxin, such as 1,000 units intracutaneously; 700 units subcutaneously; 750 intraperitoneally; 75 units intramuscularly or intracerebrally, and 50 units intravenously, did not prevent death of the rabbits from the toxin. In the case of the control non-immunized rabbits, it was found that in order to save these animals from toxin death: 20 units of antitoxin were necessary when injected intracutaneously or subcutaneously; 7.5 units, when injected intraperitoneally; 10 units, when injected intramuscularly or intracerebrally; and 5 units, when injected intraveneously.

It is evident from these results that the skin and the peritoneal tissues of horse-serum-immunized rabbits possess a capacity for reacting with horse-serum antitoxin that is approximately ten times as great as that of *in vivo* plasma, skeletal muscle or brain tissue. Stated more generally, the reacting capacity for specific antigen, or the degree of immunity, of skin and peritoneal tissues of a protein-immunized rabbit is approximately ten times as great as that of the other tissues studied. It is also clear that the skin of non-immunized rabbits possesses a non-specific fixation capacity for antitoxin greater than that possessed by the other tissues. It should be added that in these toxin and antitoxin experiments, the immunization of the rabbits with horse serum was carried out by means of an initial intravenous injection of 0.2 cc serum per kg of body weight followed by, in 10 days, a second injection of 0.1 cc per kg, given either subcutaneously or intravenously. The toxin and antitoxin injections were made 6 to 8 days after the second immunizing injection. Another method of immunization of rabbits with horse serum would undoubtedly quantitatively affect the antigen-combining capacities of the tissues investigated.

DISCUSSION

One should necessarily be cautious when discussing the significance of data which tend to upset accepted views in a field of science. Such views are often the result of cumulative scientific thought and should be questioned only after unshakable experimental proof. Yet one can not escape the conclusion from the experiments summarized in this article that immunization with a protein is not first and foremost a matter of the production of circulating antibodies; nor is it a condition wherein the reactions between serum and antigen are manifestations of immunity, while the reactions between tissue and antigen are manifestations of susceptibility. The studies herewith recorded indicate that the tissues of an animal, whether they be fluid or fixed, acquire a characteristic property as a result of immunization, namely, the capacity to detect and enter into combination with the antigen whenever they come in contact with it. If we were to take a bacterial-immunized animal as an illustration, we would consider that the reactions between serum and antigen, phagocytes and antigen, and skin or muscle and antigen, represent manifestations of the same basic response, due to a change that has taken place in the tissues as a result of immunization. These three reactions, incidentally, undoubtedly have the same immunologic function, namely, destruction of the parasite.

One is also forced to conclude from these experiments that the immunologic response of the skin, as measured by its capacity to combine with antigen, is far greater than that of *in vivo* plasma. This fact may help explain why skin tests in bacterial infections are more delicate than serum-agglutinin tests, as, for example, in *Brucella abortus* infections. Another illustration is the immunity of human skin to the staphylococci, as exemplified by the fact that, in practically all cases, whenever these organisms gain a foothold in this tissue they are prevented from entering into the deeper tissues by local destruction and outward elimination, although the serum shows no indications of the presence of agglutinins against them. It is perhaps to be expected that the immunity of the skin would be high, considering that this tissue through the ages has been the most exposed to parasitic attack. With regard to the high immunologic response of the peritoneal tissue, it is known that the cellular elements in the peritoneal cavity are apparently always in an active state.[3] It is possible that this high activity is at least in part responsible for their high antigen-reacting capacity.

Immunity is an extremely complex phenomenon and embraces a chain of responses, many of which are not identical in different animals even when the same organism is the infecting agent. The findings reported in this article apply to the rabbit, but it is believed that in a measure they apply also to man. Both the rabbit and man produce local skin reactions to antigen and show a tendency for ready antibody production as a result of immunization, and both are not susceptible to anaphylactic shock to the same extent as, for example, the guinea pig. In all probability, therefore, in man, as in the rabbit, the primary immunologic response is unitarian in nature and consists of a newly acquired capacity of all the tissues to combine with antigen; also that this capacity of the cutaneous and peritoneal tissues is many times greater than that of the skeletal muscle, brain and *in vivo* plasma.

The fate of antigen after it is injected into the tissues of an immunized rabbit is now being investigated in this laboratory by means of toxin and antitoxin experiments. Preliminary studies indicate that the union of the tissues of a horse-serum-immunized rabbit with horse-serum antitoxin is not passive but active, the latter being actually modified or destroyed in the reaction. If, for example, horse-serum antitoxin is injected into the skin of a horse-serum-immunized rabbit and, after 24 to 48 hours, a limited dose of toxin is injected into the same area, no neutralizing action is noted, indicating loss of antitoxic powers. Another problem under investigation is the extent of the antigen-combining capacity of tissues other than those studied, such as the smooth muscle tissue, lymph glands, visceral organs, etc. It is obviously of importance to investigate as many tissues as possible and thus obtain a quantitative measure of the extent of their immunologic response. It is indeed reasonable to assume that bacterial infection will be more successfully combated when the degree of immunity of all the tissues of an immunized animal has been definitely established. Studies are also being directed to the question whether in toxin-immunized rabbits, different tissues might possess different toxin-neutralizing capacities, independently of the blood plasma.

CONCLUSIONS

A method is described which makes possible the measurement of the degree of immunity of different tissues in a protein-immunized rabbit by quantitatively establishing the capacities of the tissues to react with specific antigen. By means of this method it was shown that the skin possesses a specific reacting capacity for antigen more than ten times as great as the reacting capacities of muscle, brain and *in vivo* plasma; also that the extent of this capacity of the peritoneal tissues is slightly less than that of the skin.

[3] Personal communication from Dr. Florence R. Sabin.

SCIENTIFIC EVENTS

PRESERVATION OF RECORDS IN LIBRARIES

ACCORDING to the *Technological News Bulletin* of the Bureau of Standards, lack of funds has caused the bureau to suspend, temporarily it is hoped, its studies to find the most favorable conditions for the preservation of important records in libraries. For the past four years, the various rather intangible problems confronting librarians in their attempt to save valuable publications from early decay have been studied systematically. Surveys of the conditions surrounding stored material in public libraries indicated that light, adverse temperature and humidity conditions, acidic pollution of the air and poor paper were all taking their toll. Laboratory studies of the effect of light showed that it has a more intensive effect than was commonly realized, that even high-grade book and writing papers may be rapidly weakened by its action, and that this effect may occur without visible evidence of it. Careful control of temperature, and particularly humidity, was found necessary to prevent dampness which promotes mold, or excessive dryness which makes book materials brittle. In both laboratory exposures of paper to air containing sulphur dioxide, and studies of its effect under normal library conditions, this product of fuel combustion was found to be a most potent source of deterioration. However, it was proved that this danger could be eliminated effectively and inexpensively by washing the air with an alkaline solution. Tests of old newspapers and book papers revealed the deteriorative effects of crude fibers, such as ground wood, which for a time was used more or less for all classes of publications. A partially completed study of the protection of records printed on impermanent paper indicated that a covering of Japanese tissue paper or transparent cellulose acetate sheeting might be suitable. Additional work, it is said, should be done on this problem, and on the equally interesting possibility of preventing or retarding decay of papers by the incorporation of protective materials in them. Of various materials proposed for the reproduction of records, permanent photostat paper appeared to be the most suitable.

This series of investigations was made with the assistance of a fund granted for the purpose by the Carnegie Foundation to the National Research Council.

THE DEVELOPMENT OF THE COLLECTION OF MAPS AT THE UNIVERSITY OF CHICAGO

THE development of a great map library at the University of Chicago, rivaling the collections of the national government and organized to serve scholars and business men of the Middle West, is being planned. Professor Wellington D. Jones, of the department of geography, chairman of the committee in charge, recently outlined the project through which it is hoped eventually to accumulate 400,000 sheet maps.

More than 50,000 maps now on file in the map division of the University Library form the nucleus of the proposed collection. This includes 10,000 items acquired from the John Crerar Library through the interest of J. Christian Bay, librarian. Expansion will be along four lines: first, the collection of "master" topographic maps, covering the entire civilized portions of the globe on a scale of one inch to the mile, wherever available; second, acquisition of large-scale city maps; third, accumulation of hundreds of types of maps containing special data; fourth, a collection of historical maps.

Six of the chief collections of maps in the United States are in Washington. These are those of the Military Intelligence Division, War Department, 1,000,000 maps; the Library of Congress, 688,000 maps; the Engineers Office of the War Department, 260,000 maps; the Interstate Commerce Commission, 175,000 maps; the General Land Office, 102,000 maps, and the U. S. Geological Survey, 87,000 maps. The American Geographical Society, New York, has a collection of 100,000 maps.

Among maps suggested for the collection at Chicago are those showing cities with regard to zoning, community areas, nationality, land values, rents and economic status, newspaper circulation and purchasing power, marketing districts, crime and poverty; time maps showing identical subjects at intervals, and maps showing voting trends, political unrest, standards of living, literacy and cultural traits, such as legal systems and religions. The project also calls for the collection of 3,000 atlases. It is planned to work out methods of development for cataloguing and handling the maps in cooperation with the Graduate Library School.

No funds are yet available for this project, but the university would be glad to receive as gifts all types of sheet maps, including maps in manuscript which are no longer useful to the owners.

RESEARCH CONFERENCES ON CHEMICAL PHYSICS

THE Johns Hopkins University, through its department of chemistry under the directorship of Professor J. C. W. Frazer, has instituted a series of Research Conferences on Chemical Physics to be held at Gibson Island between June 25 and July 21. The purpose of the conferences is to have lectures, discussions and demonstrations on frontier problems which are on the border line of physics and chemistry, and to afford those present a chance to acquire the latest informa-

tion in chemical physics as well as to benefit from the contacts with the specialists in the field. There will be only one formal lecture or conference a day, leaving time free for special conferences with specialists or for sports on the island. The island has an excellent golf course, perfect tennis courts, ideal swimming accommodations, and the fishing in the Chesapeake Bay which borders the island is unexcelled. A dense forest covers part of the island. The plan is a combination of conferences and vacation so arranged as to provide sufficient time for both. It is believed that the group contacts during the time of recreation is one of the opportunities which the plan affords.

The number attending will be limited, partly due to the limited facilities of the island and partly due to the desire to keep it sufficiently small to give each man registered the privilege of making contacts with specialists. All may be housed at the club house or adjacent cottages.

Since the conferences will cover frontier material, some modifications of the program may be made, depending upon the progress of work before the conferences, but the following gives the general program:

A. SURFACE PHENOMENA. Dr. Irving Langmuir. June 25–29.

The week's conferences include a series of lectures and discussions on various problems associated with "surface phenomena."

B. THERMAL ENERGY AND THE STRUCTURE OF MOLECULES. Professor Donald H. Andrews. July 2–6.

The recent developments in the quantum theory of the chemical bond have served to emphasize the importance of knowing how the thermal energy in molecules is distributed. The piling up of energy at a particular point may play a major rôle in determining the course of a chemical reaction. It is proposed to devote this week to a discussion of some of the recently accumulated evidence which can be brought to bear on the question of the distribution of thermal energy in molecules and its relation to the nature of the chemical bond. The lecturers and their subjects are: Dr. Donald H. Andrews, "The Distribution of Thermal Energy in Molecules at Low Temperatures," "The Bending of the Chemical Bond." Dr. John R. Bates, "Molecular Structure and Chemical Reactions." Dr. Charles P. Smyth, "The Effect of Dipole Forces upon the Energies of Crystalline Lattices and Molecules." Dr. Donald H. Andrews, "The Effect of Isotopes on the Thermal Energy of Crystal Lattices and Molecules."

C. HEAVY HYDROGEN. Dr. Harold C. Urey. July 9–13.

These conferences consist of lectures and discussions grouped around work in progress on the isotopes of hydrogen, as follows: Dr. F. G. Brickwedde, "Vapor Pressures of the Hydrogens and the Discovery of Deuterium." Dr. H. S. Taylor, "The Electrolytic Method of Separating the Hydrogen Isotopes." Dr. Harold C. Urey, "The Thermodynamic Properties of the Hydrogens and Their Compounds," "The Effect of Mass on the Kinetics of Chemical Reactions," "Transmutation Reactions."

D. THE STRUCTURE OF SOLIDS, LIQUIDS AND GASES. Dr. Maurice L. Huggins. July 16–20.

A series of lectures, with informal discussion, participated in by the lecturers and other research workers in these fields. Dr. Maurice L. Huggins, "Principles Determining Arrangements of Atoms, Ions and Molecules in Crystals." Dr. Sterling B. Hendricks, "Irregularities in Crystal Lattices." Professor B. E. Warren, "X-ray Diffraction in Glasses and Liquids." Professor Eric R. Jette, "Crystal Structure Studies in Metallic Alloy Systems." Dr. L. R. Maxwell, "The Structure of Gaseous Molecules as Determined by Electron Diffraction."

It is possible to register for the entire session or any week unit. This enables those having a limited vacation to attend one or more weeks as suits their convenience. Advanced registration is advisable. The special registration for these conferences is five dollars per week or twenty dollars for the four weeks. Information regarding the special rates for board and room on the island, advance registration or other inquiries may be requested through Professor Neil E. Gordon, Department of Chemistry, the Johns Hopkins University, Baltimore, Md.

THE INTERNATIONAL CONGRESS OF THE ANTHROPOLOGICAL AND ETHNOLOGICAL SCIENCES

THE first session of an International Congress of Anthropological and Ethnological Sciences will be held in London, under royal patronage, from July 30 to August 4. It is to include all those departments of research which contribute to the scientific study of man, and in their application to races, peoples and modes of life.

The congress was planned more than twenty years ago by a small international committee at the invitation of the Royal Anthropological Institute and the first session was to have been held in 1916. The congress as now established is to meet at intervals of four years midway between the sessions every four years of the International Congresses of Prehistoric and Protohistoric Sciences established in 1932. It is designed to take place in the years in which the Americanist Congress meets in Europe, as it does this year at Seville.

Meetings this summer will be held at University College, Gower Street, and at the Wellcome Historical Medical Museum. Lord Onslow is the president, and Captain T. A. Joyce, of the British Museum, chairman of the executive committee. H. G. Beasley is the treasurer, and the secretaries are A. H. Brodrick

and Professor J. L. Myres, with Adrian Digby, of the British Museum, as assistant secretary. The presidents of the various sections will be Professor G. Elliot Smith (Anatomy and Physical Anthropology), F. C. Bartlett (Psychology), Professor C. B. Fawcett (Demography and Population Problems), Dr. A. C. Haddon (Ethnography), the Rev. Edwin Smith, president of the Royal Anthropological Institute (Subsection of African Ethnography), Henry Balfour (Technology or Arts and Crafts), Professor C. G. Seligman (Sociology), Professor E. O. James (Religions) and Dr. Alan H. Gardiner (Language and Writing).

The vice-presidents of the congress include the Archbishop of Canterbury, the Lord Mayor of London, the director of the British Museum, the High Commissioners for India and the Union of South Africa, Sir James Frazer and the presidents of the Society of Antiquaries, the Folklore Society and the Royal Asiatic Society. Information may be obtained from the secretaries, care of Royal Anthropological Institute, 52, Upper Bedford Place, London, W.C.1.

SCIENTIFIC NOTES AND NEWS

DR. WILLIAM MORTON WHEELER, professor of entomology at Harvard University and dean of the Bussey Institution from 1915 to 1929, has been named an officer of the Legion of Honor by the French Government, in recognition of "his great achievements in the field of biology and in appreciation of his sympathetic understanding of the progress of science in France." Dr. Wheeler will become professor emeritus at the close of the current academic year.

DR. WERNER HEISENBERG, professor of theoretical physics at the University of Leipzig, now at Magdalen College, Oxford, has been appointed Rouse Ball lecturer at the University of Cambridge for the year 1933–34.

A BRONZE portrait bust of Frank J. Sprague, who played a large part in the development of electric transportation, was presented to the American Institute of Electrical Engineers at the opening of the recent annual convention at the Engineering Society's Building, in New York City. The bronze was the gift of the Frank J. Sprague Anniversary Committee. Frank Hedley, president of the Interborough Rapid Transit Company, made the presentation speech.

PRESENTATION of the William Lawrence Saunders gold medal for 1933 was made to Pope Yeatman, consulting mining engineer of New York City, at the annual dinner of the American Institute of Mining and Metallurgical Engineers on February 23. The medal was awarded in recognition of Mr. Yeatman's "distinguished achievements as a mining engineer; for his vision in recognizing the value of mineral deposits and his ability in successfully developing them, and for his outstanding executive ability in the management of extensive operations." Former recipients of the medal have been Herbert Hoover, John Hays Hammond, D. C. Jackling, F. W. Maclennan, D. W. Brunton and F. W. Bradley.

DR. CHARLES R. AUSTRIAN, associate professor of medicine at the Johns Hopkins University School of Medicine, was presented with the gold medal of the Phi Lambda Kappa medical fraternity at its recent annual convention in Washington, D. C. The medal is awarded annually to the "Jewish physician considered as having contributed most to medical science in the preceding year."

SIR WILLIAM LARKE, director of the National Federation of Iron and Steel Manufacturers; Professor Edward Mellanby, secretary of the Medical Research Council, and Leonard Woolley, director of the Joint Expedition of the British Museum and of the Museum of the University of Pennsylvania to Mesopotamia, have been elected members of the Athenæum Club under the provisions which empower the annual election by the committee of a certain number of persons of distinguished eminence in science, literature, the arts or for public service.

A DINNER was given in London on January 23 by the surgical staff of St. Mary's Hospital and the lecturers of the medical school to the dean, Dr. C. M. Wilson, and to Mrs. Wilson, in commemoration of the completion of the building of the new school and its opening in December by the King and Queen. Sir William Willcox presided, and presented to Dr. Wilson a silver cup, a copy of the famous Fire of London Cup, dated 1665, and a framed illuminated address with the names of all the subscribers. The raising of the necessary funds, £250,000, and the plans for the building of the new school were due to Dr. Wilson's efforts over a period of many years.

DR. JAMES R. WITHROW, professor of chemical engineering and head of the department at the Ohio State University, was recently elected a director and member of the Council of the American Institute of Chemical Engineers.

DR. WILLARD R. JILLSON, geologist of the Mid-continent and Appalachian oil fields, formerly for fourteen years state geologist of Kentucky, was elected on January 17 vice-president of the newly organized Kentucky Society of Professional Engineers.

DR. W. H. TWENHOFEL, professor of geology at

the University of Wisconsin, has been elected chairman for 1934 of the Tri-State Geological Field Conference of Wisconsin, Iowa and Illinois.

DR. H. E. C. WILSON, of the Institute of Physiology of the University of Glasgow, has, with the approval of the Government of India, been appointed professor of biochemistry and nutrition at the All-India Institute of Hygiene and Public Health, Calcutta, and will leave to take up his appointment in March.

PROFESSOR VICTOR JOLLOS, lately at the Kaiser-Wilhelm Institut für Biologie, has been appointed visiting professor of zoology and genetics at the University of Wisconsin for a term of three semesters. The appointment has been made possible by grants from the Emergency Committee in Aid of Displaced German Scholars and the Rockefeller Foundation. Professor Jollos, who reached New York on February 16, was accompanied by his family.

DR. WALTER C. LOWDERMILK, of the California Forest Experiment Station at Berkeley, California, has been appointed vice-director of the Soil Erosion Service of the Department of the Interior.

DR. ROY E. WHITEHEAD, the governor for Indiana of the National Aeronautics Association, has been appointed chief of the medical section of the aeronautics branch of the U. S. Department of Commerce, to succeed Dr. Eldridge S. Adams, resigned.

DR. CARL O. SAUER, professor of geography in the University of California, left on February 13 for Washington, D. C., to take charge of a study of land utilization for the administration. Dr. Sauer has leave of absence from February 1 to May 1.

CHARLES J. TILDEN, professor of engineering mechanics at the Sheffield Scientific School, Yale University, was recently appointed administrator of the Coast and Geodetic Survey project of the Civil Works Administration for the state of Connecticut. Some 320 men, of whom a large majority are said to be experienced civil engineers, are under his direction.

LLEWELYN WILLIAMS, assistant in wood technology in the department of botany of the Field Museum, Chicago, has been promoted to the position of assistant curator of economic botany, effective from January 1.

DR. A. RICHARD BLISS, JR., director of The Research Laboratories of the William A. Webster Company, pharmaceutical manufacturers, has been appointed vice-president of the company. He is succeeded by Dr. Robert W. Morrison, assistant to the director of research, who was formerly associate professor of pharmacology in the University of South Carolina.

DR. H. E. BARNARD, organizer and director of the Corn Industries Research Foundation, has resigned to join H. E. Barnard, Incorporated, which furnishes a consulting and technical service to the food industries at Indianapolis.

DR. HOWARD S. LIDDELL, professor of physiology at Cornell University, Ithaca, New York, left on February 17 for Leningrad, where he plans to work in Professor Pavlov's laboratory.

PROFESSOR ARTHUR E. HILL, chairman of the department of chemistry of New York University, has leave of absence during the second semester. He sailed for England on February 9 and will return in the fall. Professor John P. Simmons will serve as acting head of the department in the absence of Dr. Hill.

DR. J. EDWARD HOFFMEISTER, professor of geology at the University of Rochester, and Dr. Harry S. Ladd sailed from San Francisco on January 17 for geological work in the Lau Islands (eastern Fiji). The expedition is sponsored by the University of Rochester and is under the auspices of the Bernice P. Bishop Museum of Honolulu. The latter institution will publish the findings. As many of the Lau Islands consist of elevated coralliferous limestones and are encircled by well-developed modern reefs they offer excellent opportunities for the study of the coral reef problem. In 1926 and again in 1928 Dr. Ladd worked on the geology of the islands of western Fiji while, at the same time, Dr. Hoffmeister studied the Tongan Islands. The islands of Lau lie between these groups. The work is expected to occupy eight months.

DR. JOHN C. MERRIAM, president of the Carnegie Institution of Washington, will read a paper on "Conservation and Evolution in a Changing Social Program" before a stated meeting of the American Philosophical Society on March 2.

DR. JOHN F. FULTON, Sterling professor of physiology at the Yale University School of Medicine, delivered the Beaumont lectures, sponsored by the Beaumont Foundation of the Wayne County Medical Society, on February 19 and 20, at the Institute of Arts, Detroit. Three lectures instead of two comprised the series this year. The subject was "Studies of the Function of the Cerebral Cortex of Primates."

A. E. MARSHALL, president of the American Institute of Chemical Engineers, will speak at the Carnegie Institute of Technology on the occasion of the opening of a new chemical research laboratory on March 3 on "Glass—An Engineering Material." Following the lecture, the new laboratories of the department of chemical engineering will be open for inspection, and the new equipment will be demonstrated by students.

DR. IRA E. CUTLER, professor of zoology at the University of Denver, addressed a joint meeting of Sigma Xi and Phi Sigma at the Buchtel Club on "Birds of Colorado." He illustrated his lecture by specimens from his own collection.

DR. WAYNE DENNIS, of the School of Psychology of the University of Virginia, spoke on "Instincts in Man: an Experimental Approach," before the Virginia Chapter of Sigma Xi on February 8.

ROBERT RIDGWAY, formerly president of the American Society of Civil Engineers and at one time chief engineer of the Board of Transportation of New York City, gave an illustrated lecture on "Boulder Dam" on February 19 at the Harvard Engineering School. Mr. Ridgway is a member of the Colorado River Board.

LIEUTENANT-COMMANDER T. G. W. SETTLE, U. S. N., spoke on February 8 before the Physics Club of Chicago on "The Physics of Free Ballooning." With Commander Settle on the platform were Dempster MacMurphy, representing Colonel Frank Knox, of *The Chicago Daily News;* Major Chester L. Fordney, Marine Corps, who accompanied Commander Settle on the stratosphere flight as scientific observer; Dr. Arthur H. Compton, who introduced the speaker, and Dr. Paul E. Klopsteg, president of the Physics Club, who presided. Representatives were also present from the Union Carbide Company, the Goodyear Tire and Rubber Company and the National Broadcasting Company, who participated in various aspects of the flight.

THE new building of the Indiana University School of Dentistry, Indianapolis, was dedicated recently in a ceremony marking the fifty-fifth anniversary of the school. Speakers were Governor Paul V. McNutt; Dr. William Lowe Bryan, president of the university; Dr. James B. Carr, president, state board of dental examiners; Dr. Ezra E. Voyles, president, Indiana State Dental Association; James W. Fesler, president, board of trustees; Dr. Willis D. Gatch, dean of Indiana University School of Medicine, and Dr. Frederic R. Henshaw, dean of the dental school. The dedicatory address was given by Dr. Charles N. Johnson, Chicago. Dr. Frank A. Hamilton, president of the Alumni Association of the university, presided.

THE American Association of Cereal Chemists will meet in Toronto during the week of June 4, with headquarters at the Royal York Hotel. This is the first time that the association has met in Canada.

THE Fourth International Congress of Radiology will meet at Zurich from July 24 to 31, under the presidency of Professor H. R. Schinz. Dr. H. E. Walther, Gloriastrasse 14, Zurich, is general secretary.

Industrial and Engineering Chemistry points out that the international congresses of chemistry in Paris and Madrid offer the first general opportunity in twenty-two years for chemists of all nations to form personal acquaintances, as well as to hear and discuss reports upon the outstanding achievements in the science. In order that American chemists may take advantage of both congresses under the most agreeable conditions, it has been suggested that as many as desire go together on the same ship. The steamship *George Washington* of the United States Lines, sailing from New York on Wednesday, March 14, is said to be perhaps most convenient as to time. According to a recent public announcement, North Atlantic steamship rates were increased on January 1. Dr. Atherton Seidell, of the National Institute of Health, Washington, D. C., has offered to coordinate plans of those who intend to go and to help with the necessary arrangements. Those who are interested may obtain copies of the printed program by addressing either Dr. Seidell or the Division of Chemistry and Chemical Technology, National Research Council, Washington, D. C.

THE Committee on Grants-in-Aid of the National Research Council announces that it has received a new grant for the year 1934. Applications for support of research projects from this fund to be considered this spring must be in the hands of the committee before March 15. Formal blanks for use in applying for a grant will be furnished upon request. Announcement of awards will be made about June 1.

THE Department of Physics of Harvard University announces that for the academic year 1934–35 it has available two new research fellowships paying $1,700 each. The department will be glad to receive applications for these fellowships from men with the degree of Ph.D. or with a training substantially equivalent thereto. The holder of the fellowship will have an opportunity to gain teaching experience to the extent of about three hours a week in addition to carrying on research. A statement of the research program of the candidate should accompany the application, together with recommendations from the men under whom the candidate has done his research. Applications will be received until April 1, 1934, and may be addressed to Professor Frederick A. Saunders, chairman, Department of Physics, Jefferson Physical Laboratory, Cambridge, Massachusetts.

THE committee formed in Leicester in connection with the meeting of the British Association for the Advancement of Science there last year, had a surplus of £1,000 in hand after meeting all local expenses of the meeting. This sum has been handed over to the association, to form the "Leicester and Leicestershire Fund 1933," for the assistance of a

student or students working for the advancement of science. The fund will be administered by the council of the association, and when possible assistance will be given, preferably to a Leicester or Leicestershire student or worker. The council, in accepting the gift, has conveyed to the committee its appreciation of the action of the committee "as thus confirming, in a manner without precedent in the history of the association, their interest in the advancement of science."

IT is announced at St. John's College, University of Cambridge, that a Strathcona research scholarship (value £150 a year) and two Strathcona research exhibitions (value £40 a year) are offered for competition in July among research students who are graduates of any university other than Cambridge. Particulars can be obtained on application to the Senior Tutor, St. John's College, Cambridge.

MISS NINA SYMINGTON, daughter of the late Professor Symington, of Belfast, has bequeathed the residue of her estate, amounting to some £9,000, and to be known as the Johnson Symington Memorial Bequest, to the Anatomical Society of Great Britain and Ireland for anatomical research.

THE gradual closing up of the operation of the Civil Works Administration, which involves the dismissal of 400,000 employees at the rate of ten per cent. a week until May 21, immediately affects the scientific departments of the government as follows: The Department of Agriculture is reduced from 91,147 employees to 48,000; the Fisheries Commission from 2,349 to 650; the Bureau of Mines from 446 to 225. In addition, the Coast and Geodetic Survey must discontinue its supplementary control survey, employing about 15,030 men; the Smithsonian Institution its archeological excavations, employing 1,104, in Florida, North Carolina and other places, the one exception being the undertaking in Shiloh National Park; the Tennessee Valley Authority a large number of the 16,588 men at work on improvement projects; the Interior Department 1,762 men on soil erosion work, and the Public Health Bureau 29,779 men on malaria control work, 32,010 on rural sanitation, and 6,572 sealing mines to stop water acidity in the Ohio Valley. Projects under the Department of Agriculture which must be stopped include cattle tick eradication, involving 6,000 men; typhus-fever control operated cooperatively with the Public Health Service, 17,033 men; citrus canker control in Texas, 88; Dutch elm disease control in several New England states, 1,057; wild peach eradication, 1,112; potato weevil eradication, 211; spotted fever control, 369; mosquito pest control, 25,646, and brown-tail moth control, 5,000.

THE number of visitors received at the Field Museum, Chicago, during 1933, with the numbers reached by the extra-mural activities of the institution, such as those conducted by the N. W. Harris Public School Extension Department and the James Nelson and Anna Louise Raymond Foundation for Public School and Children's Lectures, was approximately 4,000,000 persons. The total number of visitors received during the year was 3,269,390. In addition to these, approximately 661,000 children received natural history instruction outside the museum building through the activities of the Harris Extension and the Raymond Foundation. The Harris Extension circulates some 1,300 traveling exhibits throughout the Chicago school system which are seen daily by about 500,000 children, and the Raymond Foundation sends out lecturers who were heard in 1933 by about 161,000 children in their classrooms and assemblies. The foundation also presents series of free motion pictures for children in the James Simpson Theater, which were attended by 25,950 children, and provides lecture tours of the exhibits for groups of children visiting the museum, in which 11,470 participated. The lectures for adults given in the Simpson Theater were attended by 22,787 persons and 13,312 participated in the guide-lecture tours provided for adults.

THE Department of the Interior of the Canadian Government has informed the fish and game department of the Canadian National Railways that a federal bird sanctuary has been established at Aero Lake, a few miles from Moncton. This lake has an area of approximately 200 acres and is visited annually by thousands of water fowl during the migratory periods. The establishment of game sanctuaries of this kind is being carried forward in accordance with the Migratory Birds Convention Act.

DISCUSSION

SCARPS IN TULAROSA VALLEY, NEW MEXICO

IN a recent number of SCIENCE the suggestion is made that two scarps lying a few miles east of the San Andres (not San Andreas) mountains are due to faulting in the floor of the bolson known as Tularosa Valley.[1] This suggestion seemed so at variance with the opinions held by some of us who had worked in that region as to justify some further field examination. I revisited the region, with the results outlined below, and at my request Professor Evan Just, with a

[1] C. L. Dake and L. A. Nelson, "Post-Bolson Faulting in New Mexico," SCIENCE, 78: 2017, p. 168, August 25, 1933.

party of students, also examined the scarps under discussion; his conclusions are in essential agreement with mine.

The easternmost scarp described by Dake and Nelson was readily located, as the road measurement checked their stated figures within a tenth of a mile. The road here runs west on a section line, and the scarp is only a few hundred feet west of the recently established corner common to sections 4, 5, 8 and 9 of T. 14 S., R 6 E. Reference to the Tularosa quadrangle topographic sheet shows that this township was unsurveyed at the time that the map was made, and the present road is not mapped. Projection from adjoining township lines on the map shows that this particular section corner is located almost exactly on the shore line mapped as surrounding the area designated "Alkali Flat." This flat is the lowest part of the basin crossed by this road. The near-coincidence and essential parallelism of this shore line and the escarpment are too striking to be ignored.

Dake and Nelson make the point that both of these scarps are "considerably west of the center of the Tularosa basin." This is true; but the scarps lie immediately adjacent to, and in fact form part of the boundaries of, the flat at the bottom of the basin, and are within less than a mile west of the lowest point in this latitude. The asymmetry of the basin produces some surprising optical illusions with regard to slope and level.

Dake and Nelson say of these scarps, "Neither one, at least within sight of the highway, shows any indication of an opposite facing cliff." The observer is quite willing to agree with this statement; but a sight with a telescopic level revealed an unmistakable water-line, across the flat to the east at a distance of 1.2 miles, on the same level as the base of the easternmost escarpment. The illusion is such that this water line appears to be fully forty feet below the observer, and the evidence of the telescopic sight was doubted until it was checked from the other side. Later scaling from the topographic map showed that this water-line checked in position with the line mapped as the opposite shore of the Alkali Flat.

Near the point where the road crossed it, this easternmost scarp had its face covered by wash and slump material from the top, but less than a mile to the north from the road the face of the scarp is fully exposed. It shows at the bottom a layer of very dense water-laid clay, overlain by several inches of medium coarse stratified sand, and topped by several feet of unstratified gypsiferous wind-blown silt. The sandy layer is wet, apparently from water seeping eastward, and dips easterly at about two degrees; if this scarp were the face of a fault block, the beds would have been tilted toward the west.

Dake and Nelson have apparently overlooked one feature, which is not very prominent along this road, but is the dominant topographic factor in other parts of Tularosa Valley; that is, the fact that the actual floor of the valley is exposed only at its lowest points, and is covered elsewhere, very irregularly, with wind-blown material. These aeolian mounds vary in substance, ranging from the fine silt in Estancia Valley to the north, through dune sands carrying a high gypsum content, to the unique White Sands, of nearly pure gypsum, at the southern end of Tularosa Valley. The material at the top of the scarp under discussion is intermediate in character between the fine silt found farther north and the sand found farther south; but it contains enough gypsum to show, in a subdued degree, the tendency toward cementation previously mentioned[2] for the gypsite hills in the White Sands area. There are in Tularosa Valley literally hundreds of large and small flats that occupy low places rimmed by such wind-built mounds. Many of these flats show a steep east- or southeast-facing bank, which is the steep leeward front of the aeolian deposit, perhaps oversteepened by wave-cutting. The opposite bank, in most cases, slopes very gently; if it ever had a wave-cut cliff, this cliff has been buried under the fresh wind-blown material cast up from the flat after each period of drying.

The scarp under discussion can be followed north of the road for nearly a mile, where it swings around to the west, and passes gradually into an ordinary water-line on a gently sloping surface. This water-line was not followed throughout its length, but it appears to swing around to the north and join with the westernmost scarp described by Dake and Nelson. Reference to the topographic map shows that this shore-line is so plotted.

Dake and Nelson say: "The fact, also, that though both of these scarps face east,[3] the crest of the western one is at a lower elevation than that of the eastern is . . . indicative of fault origin." This argument is not entirely clear, even on the faulting hypothesis; and, inasmuch as these crests are wind-built mounds, any difference of elevation is indicative of nothing at all, except that one was built higher than the other. A telescopic level sight, taken from the water-line north and west of the easternmost scarp, cut the westernmost scarp near its base, indicating substantial coincidence of level, and not a fifty-foot difference, as estimated by Dake and Nelson.

The back-slopes, from the tops of these scarps toward the west, do not indicate any tilting of the floor of the valley, but are simply the back-slopes of

[2] S. B. Talmage, "The White Sands of Tularosa Valley" (abstract), *Bulletin of the Geological Society of America*, 43: 1, p. 185, 1932.

[3] Actually, south 50 degrees east.

the wind-laid cover; the actual floor of the valley is the east-dipping sand layer on top of the clay.

The profiles of these escarpments are distinctly suggestive of new fault blocks, and according to their own statement, Dake and Nelson based their fault hypothesis on profiles only, as viewed from the road. Further study of alignment, continuation into water-lines, character of material, structure and coincidence of levels makes the fault hypothesis wholly untenable.

These are not fault scarps. They are simply two wave-cut cliffs in wind-built mounds, lying essentially parallel and arranged *en echelon* on the zigzag shoreline of the same lake.

STERLING B. TALMAGE
NEW MEXICO SCHOOL OF MINES

LIGHTNING PROTECTION FOR TREES

REFERRING to my brief article on this subject in the December 1, 1933, issue of SCIENCE, Dr. M. G. Lloyd, of the Bureau of Standards, takes exception, in the issue of December 29, to my statement that the slow discharge from the point of a lightning rod tends to minimize the probability of a direct stroke to the rod. The grounds for his criticism are apparently limited to a belief, which he states is held by those who have studied the general experience with lightning rods, that the points do not function as indicated. Dr. Lloyd quotes no specific observations, experiments nor measurements. On the other hand, he admits that the results of controlled laboratory studies indicate the effectiveness of point discharge to the lowering of over-all potential difference.

In my article, it is clearly pointed out that the protective value of a lightning rod point is directly related to the rate at which it discharges, and that often the accumulation of potential difference by the approach of a thunder cloud may be so rapid as to offset completely any lowering due to point discharge, with resulting direct stroke to the rod. This certainly happens in many and perhaps the majority of cases. There are, however, no certain records and apparently no available methods for determining whether, even in these cases, the intensity of the stroke is not diminished by the foregoing discharge of the point.

Certainly the claim that the rod point has no value in reducing over-all potential would appear to be an extreme one. There is in fact much indirect experience to the contrary. Laboratory experiments readily show such value. Visual discharge from elevated points of all character is frequently visible, even in the absence of storm clouds, as, for example, in St. Elmo's fire, the discharges from mountain peaks and particularly from lightning rods. Experimental points on the latter have been found to be melted without any evidence of lightning stroke. Even in storms, lightning rods have been frequently seen to discharge with streamers of varying length, some of them reaching to great heights, thus giving evidence of moderate discharges, which do not, however, mount to the magnitude of a direct stroke or completed cloud discharge. Certainly the most important return from the initial cost of a lightning rod is in its function of receiving the stroke when it comes. On the other hand, the view that the rod never serves to prevent a direct stroke nor to minimize its intensity seems to me to be somewhat extreme and to be not justified by existing record.

JOHN B. WHITEHEAD
THE JOHNS HOPKINS UNIVERSITY

WEIGHTS AND MEASURES AND THE PUBLIC

A FEW years ago a butcher drowned himself in one of Minneapolis' million dollar reclaimed lakes because he was indicted on the ground that his pounds of meat were not sixteen ounces. Had he taken the trouble to can his meat he might have saved himself this disagreeable experience, as I understand that during the Hoover administration the "pound can" was "standardized" to fifteen ounces.

Few people know that the United States Government does not possess a standard yard, and there is no assurance that the yard standards of the different states are the same. The land surveys in Texas are made on the Spanish yard or "vara," whereas when one crosses the border into Mexico he finds the meter is used rather extensively. A typical American reaction to the metric system is expressed in a remark made by our mechanic, who stated that a professor asked him to cut a metal bar exactly one meter and one inch long. In 1916 there was a bill before a Congressional committee on the legalizing of the Centigrade thermometer. At the same time millions of Centigrade thermometers were being manufactured in this country and sold abroad. Americans have claimed that it is impossible to change to the metric system because of the expense of changing machinery. At the Baltimore fire, the fire apparatus sent from New York, Washington and Philadelphia did not fit, and a meeting of fire chiefs was held, but they could not agree, and so they called in Stratton, director of the Bureau of Standards, to suggest a standard coupling. He gave them a figure in fractions of an inch, but it was really a metric thread and his suggestion was accepted without question.

In Tokyo in 1932 I saw a procession which was said to be a celebration of Buddha's birthday. The next day I traveled to Sendai; the day following I saw a procession which looked similar to the one seen at Tokyo since I could not read the Chinese characters, and I asked my interpreter if Buddha's birthday was on a different day in Sendai from Tokyo. He replied

that it was an advertisement of the metric system. I noticed that, although some stores were selling cloth measured in "shaku" and other ancient units, the size of shirts was in centimeters and distances by railroad were in kilometers.

A technician in a medical laboratory was trying to follow directions in a manual which called for a test-tube 20 millimeters in diameter. Not being familiar with the millimeter, she looked it up in a handbook and found that there were 25 millimeters in an inch, approximately. She marked her height on the wall, divided it into inches and then divided the inch into 25 parts. Such processes are often necessary in changing from one system to another. To avoid calculations as much as possible (at present when many people are out of work) it would be well to change over a great many measures into metric units (and to correct a number of errors).

Our grandfathers were told that a billion is a million million, and we find this usage in all the world except the United States. One of our Congresses spent a thousand million dollars and called it a billion, and ever since then ("by act of Congress") a thousand million has been a billion to us. In water analyses, if we express figures in "parts per billion," they are not understood by foreigners, so we have to explain them as (for instance) micrograms per kilogram or milligrams per metric ton. Until recently we have had little use for the unit microgram, and many persons abbreviate it by the Greek letter γ. One often sees the amount of a chemical substance recorded in so many "gammas" as though a gamma were a unit of measure instead of a unit of the alphabet. A more serious error is often made in the conception of the micro-meter, which is a millionth of a meter and not a thousandth of a millimeter. A micro-meter is abbreviated μ, and the micro-micro-meter $\mu\mu$. Many persons imagine that a micro-meter is a thousandth of a millimeter and suppose that a micro-micro-meter is a thousandth of a micro-meter, whereas it is a millionth of a micro-meter.

The "Western" scientist will not read a scientific paper if it is written in Chinese characters. We demand that the writer use the Latin alphabet. At the same time we are very careless in units of weights and measures. Perhaps in this period of unemployment the teaching of the metric system to a larger part of the population might be of advantage.

J. F. McClendon

University of Minnesota

REFLECTIONS ON TWO SCIENTIFIC NEWS ITEMS

Two news items in Science for January 26 call for further comment. On page 76 the destruction by fire of Morrill Hall, of the University of Tennessee, is recorded. This means the loss to science of the Gattinger herbarium, on which the flora of the state, published in 1900, was based, as well as early collections by Ainslie, Bain, Kearney, Lamson-Scribner, Ruth and others. All these were of great scientific value, and are largely irreplaceable, since the native flora of vast areas has since been destroyed by lumbering, agriculture, grazing, etc. This serious blow to students of taxonomy and plant geography may well lead to queries: How many other botanical collections of historic and scientific importance are at present housed in buildings subject to destruction by fire? Can not some steps be taken to provide safer quarters for them?

On the preceding page it was noted that the director of a certain government organization is to retire by reason of age in June, but instead of receiving the usual pension of $1,200, he is to be made director emeritus at $5,000 per year. At the present time many eminent government scientists are being laid off with the same pension as is received by watchmen and stenographers. A few years age Dr. L. O. Howard, chief of the Bureau of Entomology and one of the leading scientists of the present day, was retired under such circumstances, and I have yet to notice in the pages of Science that any bill has been introduced into the Congress to make him chief emeritus at a salary commensurate with his value to the government. Query: How much of the people's money is being spent on special pensions for government workers who have succeeded in gaining political favor? Are any scientists being thus aided, in proportion to their ability, productiveness or usefulness to our country?

Edgar T. Wherry

University of Pennsylvania

WARNING CONCERNING AN IMPOSTOR

I am writing a note of warning to readers of Science against a clever impostor who has been making the rounds of colleges—Minnesota, Iowa, Illinois, etc. He has a very clever story, doesn't ask for money, but in a number of known cases has received contributions. He works up each case to fit his "prospect," who was the classmate or friend of his "father" or "grandfather" in college. He will know all about his prospect.

According to his story, he was driving across country to fill an interneship at Toronto; met with an accident (at a place to fit each case); left about all of his money to bond himself, and was left short of funds, after buying his ticket to Toronto.

He is rather dark, dark hair, rather slight build, about 5 ft., 7 in. in height and about 26 years old.

Charles P. Sigerfoos

The University of Minnesota

SCIENTIFIC BOOKS

HEREDITY AND ENVIRONMENT IN MAN[1]

FOR eugenics' progress good stock is essential and its reproduction is to be promoted. But how shall we know good stock when we see it? Certainly, it must be able to breed offspring who are intelligent and who have a socially fitting personality. And we shall know the degree of intelligence and of socially fit personality when we can measure that degree. But even after we have measured the degree the question arises: In how far are intelligence and personality really bred and in how far dependent upon training or, in general upon environment? This is the problem that Mr. Frederick Osborn has set, and the answer is to be found in the volume by Miss Gladys C. Schwesinger.

With incredible industry Miss Schwesinger has sought in hundreds of papers and scores of books material for her answer. The history of mental measurement is traced from its beginning and the modern results skilfully classified and described. The measurement of personality is more difficult, but lines of approach are being followed; and these are fully set forth.

For the problem of heredity and environment recourse has been had to the data from "identical twins" reared apart, on the one hand, and unrelated children reared together, on the other. Of course, a trouble here is that, on account of the selective nature of the individual, twins reared under "dissimilar" environments are making most use of the similar elements in such environments and unlike children placed in the same environment are picking up very different things out of that environment. A similar treatment can not be given to dissimilars; nor, within limits, a dissimilar treatment to identical twins.

Finally, a chapter discusses view-points on personality. This is not quantitative. Here are considered endocrines, psychoanalysis and the views of the behaviorist, Gestalt psychologist, and the social psychologist. This chapter is necessarily somewhat unformed, as our views in this field are yet philosophical rather than scientific.

The book is an excellent guide to a difficult field. The author has been industrious, selective, critical. Of much help will be the bibliographies and recommended readings. Nowhere else, we venture to say, can so comprehensive a survey be found. The book is recommended to all who wish to understand the genetic basis for behavior and the way behavior may be studied.

CHARLES B. DAVENPORT
CARNEGIE INSTITUTION OF WASHINGTON

[1] "Heredity and Environment: Studies in the Genesis of Psychological Characteristics," by Gladys C. Schwesinger. (Ed. by Frederick Osborn), 479 pp. N. Y.: Macmillan, 1933. $4.00.

THE PHYLOGENY OF APES AND MAN

Functional Affinities of Man, Monkeys and Apes. A Study of the Bearings of Physiology and Behaviour on the Taxonomy and Phylogeny of Lemurs, Monkeys, Apes and Man. By S. ZUCKERMAN. Harcourt, Brace and Company, New York, 1933. Pp. xviii + 203, with 4 figs. and 12 plates.

THIS stimulating and novel attempt to throw more light on the ultimate problem of man's phylogenetic place among the primates ends with the cautious statement: "It is indeed plain that we have still to wait before the fossil record will be able to provide the answer to a question which studies of anatomy and physiology fail to reveal. The available evidence can not even deny the possibility of man's independent evolution from as far back as the Oligocene, and through the Miocene up to the present day."

The author deserves great credit for his courage and optimistic labors in having collected a fair part of the rapidly accumulating recent results of comparative studies on functional characters of primates. In a pioneering enterprise, such as this volume represents, the introductory chapters are of more than usual interest. This can best be indicated by the following few random quotations which reveal the author's critical and frank attitude: "A survey of the literature suggests that present-day morphologists, perhaps because of the greater age of their subject, are more cautious with regard to the phyletic bearings of their work than are students of function." ". . . the real meaning of taxonomy . . . has in some quarters been narrowed to mean classification on the basis of a few arbitrary structural characters." ". . . the phylogeny of the Primates is mostly a preoccupation of anatomists with a medical training, whereas animal phylogeny as a general study is a problem of professional zoologists." "The anatomist . . . usually approaches the problem from a totally different angle, long acquaintance with the human form giving him a somewhat unwarranted confidence in the systematics of the *Hominidae*." ". . . the main result of this arbitrary 'anatomical' treatment of the bony remains of archaic men is that to-day we accept an altogether irrational classification for the family *Hominidae*." ". . . primate material has a peculiar power of overweighting the conclusions of its students." After these and many other more or less deserved criticisms of methods and conclusions underlying the ineradicable and confusing controversies in regard to the descent of man the reader is prepared to listen to evidence of a new nature. This the author contributes by specializing in seldom used approaches to the problems of primate classification and evolution. The selection of topics can at present be only very incoherent and is not always restricted to really func-

tional characters. The wide variety of the subjects discussed is shown by the following abbreviated list: blood groups, serum precipitin reactions, purine metabolism, sexual skin, breeding season, menstrual cycle, nursing position, finger grooming, drinking by suction, behavior and intelligence in general, cortical physiology, different aspects of vision, facial movements and expression, diseases and parasites, and hybridization. Under the last-named heading are to be found specially noteworthy lists of inter-generic and inter-specific crosses in primates.

The chief value of most of the chapters consists in the convenient collection and condensation of previously scattered reports by specialists in many widely differing fields, rather than in the more or less tentative taxonomic and evolutionary conclusions. Even though it is quite evident that no systematic attempt was made to consider all the available information, this book is nevertheless sufficient proof that our knowledge of the functional characters of primates is still far too fragmentary to permit many deductions bearing upon the more specific questions of primate relationships beyond those already gained from far more extensively grounded morphological studies. It is very gratifying, however, that the phylogenetic conclusions from the data collected in this volume do in no way clash with the generally accepted classification of at least the various primate families. Such additional support of a provisionally established classification is of great significance, since any classification, to become reliable, must be based upon as many different characters as possible, ultimately representing the carefully weighed compromise between often apparently conflicting results.

Since a reviewer can rarely agree with all the minor assertions of another author, a few such differences of opinion or experience may be indicated here: There still exists a good deal of justification for doubting the author's flat denial of a breeding season in Old and New World monkeys (*e.g.*, in the reviewer's field experience *Oedipomidas* and *Saimiri* do not breed during the summer months). The chapter on facial expression would have greatly benefited by a consideration of the corresponding work by the late E. Huber. The table on brain- and body-weights of *adult* primates includes a considerable number of misleading records on extremely immature or else abnormal specimens. To mention but one instance: The mean body-weight of four "adult" male *Ateles geoffroyi* is given as 2.0 kgms, whereas the reviewer obtained an average of 7.4 kgms for a large series of really adult males of this species.

Dr. Zuckerman's excellently written book will be a great challenge for and help in future work on the comparative physiology and psychology of primates. The volume is illustrated by beautiful photographs of different types of primates and contains an extensive bibliography and a useful subject index.

ADOLPH H. SCHULTZ

SOCIETIES AND MEETINGS

THE INDIANA ACADEMY OF SCIENCE

THE forty-ninth annual meeting of the Indiana Academy of Science was held at Bloomington, Indiana, on Thursday, Friday and Saturday, October 12, 13 and 14, 1933, with Indiana University as host. The executive committee meeting was held on Thursday evening. At the general meeting on Friday morning, after an address of welcome by President W. L. Bryan, of Indiana University, the following three general papers were presented: "Indirect Contributions to the Promotion of Science," by Dean William M. Blanchard, DePauw University; "Some Botanical Aspects of the Hawaiian Islands" (illustrated), by Dr. T. G. Yuncker, DePauw University; "Moving Pictures of Leaf-Cutting and Army Ants," by Dean Howard E. Enders, Purdue University. In the sectional meetings a total of 101 papers on botany, bacteriology, chemistry, geology, physics, astronomy and zoology were presented.

The annual dinner was held on Friday evening in the Union Building, Indiana University, with about two hundred members and guests present. Following the dinner, the academy president's address, an illustrated lecture on "Origins of Indiana Mammals Living and Extinct," was given by Dr. Marcus W. Lyon, Jr., of South Bend. The Junior Academy held its meeting and exhibit on Saturday morning. Dean Howard E. Enders reported nine affiliated Junior Academy of Science organizations.

The following officers were chosen for 1934: *President,* J. A. Nieuwland, University of Notre Dame; *vice-president,* M. L. Fisher, Purdue University; *secretary,* R. C. Friesner, Butler University; *assistant secretary,* W. P. Morgan, Indiana Central College; *treasurer,* Paul Weatherwax, Indiana University; *editor of the Proceedings,* S. A. Cain, Indiana University; *press secretary,* Will E. Edington, DePauw University.

The semi-centennial meeting will be held next November in Indianapolis, with Butler University as the host. Special efforts are being made to have all living charter members, other prominent members and former members living outside Indiana present and participating in the program, which, it is hoped, will include scientific papers of unusual merit as well as several special papers of historical nature pertaining to the founding and early development of the Indiana Academy of Science.

This meeting will bring to a close a half century of scientific progress in Indiana. Many noted men, such as David Starr Jordan, Barton W. Evermann, John M. Coulter, John C. Branner, T. O. Mendenhall, O. P. Hay, J. C. Arthur, W. A. Noyes, Harvey W. Wiley, W. S. Blatchley and others have been active in the development of the academy, and it is the intention to honor these men at this semi-centennial meeting.

WILL E. EDINGTON,
Press secretary

THE COLORADO-WYOMING ACADEMY OF SCIENCE

THE seventh annual meeting of the Colorado-Wyoming Academy of Science was held on December 1 and 2, 1933, at the University of Wyoming, Laramie, Wyoming.

Friday afternoon and Saturday morning were given over to the reading of papers in section meetings. A total of 118 papers were presented—in chemistry 15; education 11; geology-geography 11; physics 16; plant science 25; psychology 9; social science 6; zoology 25. About 200 members and students attended the sessions.

At the annual dinner Dr. Aven Nelson, of the University of Wyoming, reported on "The Fifth Pacific Science Congress." Robert Niedrach, of the Colorado Museum of Natural History, showed moving pictures of Colorado wild life.

The officers for 1933–4 are: *President,* R. J. Gilmore, Colorado College; *vice-president,* H. M. Barrett, University of Colorado; *secretary,* W. C. Service, Colorado College; *treasurer,* C. T. Hurst, Western State College; *chairman of publications,* C. A. Hutchinson, University of Colorado; *representative to the conference of state academies,* J. C. Stearns, University of Denver. Members of the executive committee are: F. F. Ramaley, University of Colorado; A. S. Adams, the Colorado School of Mines; T. R. Garth, University of Denver; F. P. Goeder, Colorado Agricultural College; Laura A. White, University of Wyoming; P. E. Boucher, Colorado College; F. C. Jean, Colorado State Teachers College, *retiring president.*

The 1934 meeting will be held on November 30 and December 1, 1934, at the Colorado School of Mines, Golden, Colorado.

RALPH J. GILMORE,
Secretary

SCIENTIFIC APPARATUS AND LABORATORY METHODS

A METHOD FOR STUDYING SOIL–PLANT NUTRIENT RELATIONSHIPS

SOIL investigators have given considerable attention to methods for displacing the soil solution, that may be comparable to the effect of plants in drawing nutrients from soils. The use of air pressure applied to soils in order to force nutrients in solution from the soil into plant roots and thence up through the stem of the plant to be collected and analyzed, is thought to be a new method of studying the relation between soil conditions and the intake of various soil solubles.

Briefly, the procedure consists of placing a suitable receptacle containing the root systems of plants grown in a nutrient medium, after the tops have been removed, into a pressure chamber and connecting the plant stubs to receiving flasks outside of the pressure chamber by means of glass and rubber tubing, then applying air pressure to the closed chamber. Field bean plants grown in soils were used in an investigation by this method and a relatively large volume of solution was obtained by the application of thirty pounds per square inch of air pressure to the soil at optimum moisture content in from twelve to twenty-four hours. Interesting data relative to soil and plant treatments and the growth of plants were obtained by analyzing the solutions collected.

This method offers a profitable means of attack in the investigation of problems in soil fertility and plant nutrition. Some special problems to which it may be applied are as follows: (a) The relation of the concentration of substances entering plant roots to their concentration in the nutrient medium; (b) the effects of the presence and concentration of an essential or non-essential element in the nutrient medium on the intake of other elements; (c) the specific nature of the ions that enter plant roots and the physical or chemical processes involved; (d) the effect of various soil conditions on the intake of soil solubles by plant roots.

The results of the investigation with bean plants, using the air pressure method for obtaining the solutions, will be published at an early date.

C. W. LAURITZEN

MICHIGAN STATE COLLEGE

A SIMPLE STAIN FOR NUCLEAR STRUCTURES IN LIVING AMOEBAE AND CYSTS

AMONG the practical methods for the identification of intestinal amoebae, iodine solutions have been much used. They are simple, act immediately and show the nuclear chromatin distribution well enough for purposes of differentiation between species. Eosin or

neutral red in dilute solutions are also useful for bringing living amoebae and cysts into contrast with the associated fecal debris.

The proposed staining solution is methyl alcohol saturated with methylene blue. This combines and surpasses the virtues of iodine and eosin solutions. If a small amount of feces is emulsified in a drop of water, an equal-sized drop of this stain mixed with the emulsion and a cover glass placed on the preparation, cysts and motile forms of amoebae will stand out as clear refractile bodies in the dark blue field. All fecal remains, with the exception of certain crystals, are stained dark blue and are thereby merged with the rest of the blue field. The whole preparation may be searched with the low power objective in a very short time. Examination with the 4 mm or oil-immersion lens will show the nuclear chromatin of amoebae and cysts to be selectively stained with the methylene blue. Chromatin beads about the nuclear membrane and karyosomes appear as distinctly as in haematoxylin stains of fixed preparations. The only precautions to be observed are to reduce the amount of light and to make thin preparations; either use small drops of fecal emulsion and staining solution, or use large coverslips to spread the mixture over a larger area.

Trophozoites are rounded up by contact with the methyl alcohol, but the nuclei may be seen distinctly, even in the presence of much ingested material. Frequently cultures of intestinal amoebae do not develop cysts, so that the diagnosis must be based on active forms. If these have ingested much particulate matter, especially starch particles, iodine is practically useless for staining the nucleus.

Castor oil and mineral oil droplets in feces are stained a light greenish-blue by this stain and do not have the clear refractile appearance of cysts.

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SPECIAL ARTICLES

THE ISOTOPIC FRACTIONATION OF WATER BY PHYSIOLOGICAL PROCESSES[1,2]

ABSTRACT

DURING the process of the synthesis of organic compounds by a growing willow tree, an isotopic fractionation of hydrogen occurs, in the direction of a preferential selection of the heavier isotope, with the result that the sap and the combined hydrogen of the woody parts of this plant both yield heavy water. No isotopic fractionation occurs during the passage of the water into the tree through the root membranes.

(1) INTRODUCTION

During the growth of plants, water is imbibed through the roots, and hydrogen from this water is then utilized by the plant in the photosynthesis of organic compounds. In both of these processes there exists the possibility of an isotopic fractionation, that is, the possibility of a selective action of the organism with respect to the light and heavy isotopes of hydrogen. The purpose of this investigation was to determine whether any such selective action occurs.

(2) PERMEABILITY OF ROOT MEMBRANES TO LIGHT AND HEAVY WATER

In August, 1932, an experiment was started for the purpose of ascertaining whether an isotopic fractionation of water takes place during osmosis through the roots of growing plants. In this experiment cow peas were first employed. The plants were wax-sealed through holes in the tight cover of a large jar containing 30 liters of tap water. Nutrient salts and oxygen by aeration were supplied as needed.

After about three months, during which time 12 liters of water had been evaporated, the cow peas succumbed to an attack by aphids and were replaced by plants of Indian corn. When these had consumed one liter of water (1 month), they in turn perished during a cold winter's night and were replaced by rooted twigs of the weeping willow and the experiment continued during the winter. By April 18 only 225 cm^3 of the original 30 liters of water remained. After careful purification, the density of this residual water was measured and found to be normal (± 1 ppm).

The experiment was then repeated, this time entirely with growing willows. This was in the summer of 1933 and transpiration was much more rapid than in the first experiment. Again the residual water from 30 liters was found to have normal density (± 1 ppm).

In a third experiment a sample of heavy water (sp. gr. 1.000,053) was reduced from 370 to 165 cm^3 by transpiration through willow, and the residual water was found to be unchanged in density (± 1 ppm).

From these experiments it is evident that the light

[1] Publication approved by the Director of the Bureau of Standards, U. S. Department of Commerce.

[2] Most of the experimental results presented in this paper, together with a description of the methods employed in purifying the water and in measuring its density, will be given in a forthcoming publication,—*Bur. Standards Jour. Research*, 12, 1934.

and heavy water molecules diffuse through the root membranes in the proportions in which they are present in the water, that is, no appreciable isotopic fractionation occurs in this process.

THE ISOTOPIC COMPOSITION OF THE SAP WATER AND OF THE COMBINED HYDROGEN OF A WILLOW TREE

Although no isotopic fractionation occurs during the ingestion of water through the roots of the growing plant, there remains the possibility that an isotopic selection may take place within the plant as a result of evaporation or of photosynthesis. In order to obtain information on this question the following experiments were made.

In the summer of 1933 a quantity of branches and leaves were secured from a young willow tree (*Salix nigra*) growing on the bank of a small stream. The green branches were wrapped for transportation in a waterproof blanket and taken to the laboratory. The next day they were placed in a large iron pipe and heated to 150° C. in a current of dry nitrogen. The expelled sap water was condensed and collected. The temperature was then raised to the ignition point and the dry wood was burned in a current of dry oxygen. The water resulting from this combustion was also condensed and collected.

The organic matter in both samples of water was destroyed by wet combustion with alkaline permanganate, and the density of the water, after careful purification, was measured, with the following results:

Sap water (A) Δ^a, ppm (± 1)	Water from the combined hydrogen (B) Δ^a, ppm (± 1)
2.8	5.5
2.8	5.2
—	—
2.8	5.4

[a] Δ = Excess density as compared with "normal water," in parts per million. The source of the normal water used for comparison was the Potomac River.

Both samples of water were therefore heavier than normal by small but significant amounts.

In order to determine the nature of the isotopic change which had occurred, the following experiments were made, in accordance with the methods of isotopic analysis first employed by G. N. Lewis.[3] A colloidal solution of platinum containing platinum black in suspension was prepared in the water of sample B, and normal hydrogen gas was bubbled through it for 24 hours.[4] After purification its density was found to be unchanged ($\Delta = 6.3 \pm 1$). The reaction with hydrogen gas under these conditions is apparently not sufficiently rapid to completely normalize water with respect to hydrogen.

In order to make sure that the oxygen of the water had the normal isotopic composition, the sample was then given an extended treatment with dry CO_2, followed by distillation from a large excess of solid K_2CO_3. Again no change in density occurred ($\Delta = 6.4 \pm 1$).

Finally the water was saturated (approximately) with dry gaseous NH_3 and then desaturated, the process being repeated six times. This treatment lowered the excess density to $\Delta = 3.1$, a drop of 3 ppm, thus showing definitely that the heavy water contained a higher percentage of the heavy isotope of hydrogen (deuterium) than normal water.

CONCLUSIONS

During the process of the synthesis of organic compounds by a growing willow tree, an isotopic fractionation of hydrogen occurs in the direction of a preferential selection of the heavier isotope with the result that the sap and the combined hydrogen of the woody parts of the plant both yield heavy water. Whether this preferential selection of deuterium is beneficial, detrimental or innocuous to the organism can be determined only by further experimentation.

If the phenomenon is general in the vegetable kingdom, it is probable that many of the organic compounds which we obtain from plants (*e.g.*, oils, carbohydrates) do not, in their native state, have normal isotopic composition. Many of them (those containing ionizable hydrogen) would, however, be normalized, at least partially, if in the process of extraction or purification they are treated with water; as in the case of the starches and sugars, for example.

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HEREDITARY VARIATIONS IN THE BLOOD CYTOLOGY OF NORMAL RABBITS

STUDIES in this laboratory have demonstrated wide variations in the blood-cell formulae of normal rabbits comparable in magnitude with variations in coat color, size, body and organ weights, and other constitutional factors. Except for minor seasonal fluctuations these differing blood-cell formulae were found to be fairly stable during conditions of health and vigor and to be closely related to the natural resistance of the rabbit host to several experimental and spontaneous diseases. It seemed quite likely, therefore, that the differences in the blood formulae were largely inherited differences, just as the color of the

[3] *Jour. Am. Chem. Soc.*, 55: 3502, 1933, and *Jour. Chem. Phys.*, 1: 343, 1933.

[4] *Cf.* J. Horiuti and M. Polanyi, *Nature*, 32: 819, 1933.

[5] The death of Dr. Washburn occurred on February 6.

coat, the blood groups,[1,2] abnormalities in the skeletal and cranial bones, etc. To substantiate this point the blood-cell formulae of standard varieties of rabbits were studied. In this study there were 146 adult male rabbits from 8 standard breeds, distributed as follows: 24 Havana, 19 Himalayan, 14 Belgian, 24 English, 16 Polish, 18 Dutch, 18 Beveren and 13 Rex animals. These breeds have been propagated in pure line in this laboratory from 3 to 8 years. The animals used were comparable as to age (average age 8.1 months) and physical condition and were examined in large groups diversified as to breed. Uniform diet and housing conditions were maintained. An average of 3.3 hematological observations were made on each individual rabbit distributed over a period of 2.1 weeks, including 4.0 red cell, platelet and hemoglobin estimations, 5.4 total and 6.3 differential white cell counts. The mean blood level for each cytological factor was computed. A statistical analysis of the material revealed that the blood cytology of individuals of the same breed was more alike than the blood cytology of individuals of different breeds. It was apparent that characteristic and typical blood formulae existed for each variety of standard breed rabbits studied and that the standard breeds in our laboratory could be identified on this basis. The chances of this being due to a random association of circumstances are remote, since for 11 of 14 blood factors the variance between breeds was significantly greater than the variance within breeds. (Red blood cells, $z = 0.92$, $P. = 0.01-$; hemoglobin, $z = 0.95$, $P. = 0.01-$; platelets, $z = 0.70$, $P. = 0.05-$; white blood cells, $z = 0.74$, $P. = 0.05-$; neutrophiles per cmm., $z = 0.10$; basophiles per cmm., $z = 1.06$, $P. = 0.01-$; eosinophiles per cmm., $z = 0.61$, $P. = 0.05-$; lymphocytes per cmm., $z = 1.17$, $P. = 0.01-$; monocytes per cmm., $z = 0.34$; neutrophiles in per cent., $z = 0.88$, $P. = 0.01-$; basophiles in per cent., $z = 1.12$, $P. = 0.01-$; eosinophiles in per cent., $z = 0.67$, $P. = 0.05-$; lymphocytes in per cent., $z = 1.07$, $P. = 0.01-$; monocytes in per cent., $z = 0.07$). The most striking variations between the eight breeds were in the values for the basophiles, lymphocytes, red blood cells and the hemoglobin. It is interesting and perhaps significant that this should be the case, since these latter factors were found to be reliable indices of the natural resistance of rabbits to inoculation with a transmissible malignant tumor or with the spirochete of syphilis. The lymphocytes were found to vary from a level of 3,780 per cmm. for the Polish breed to levels of 1,810 and 2,030 per cmm. for the English and Havana; the basophiles from 680 to 690 per cmm. in the Belgian and Beveren to 320 and 360 per cmm. for the Polish, Havana and Dutch; the red blood cells from 5,730,000 per cmm. in the Havana to 4,870,000 in the Rex; and the hemoglobin from 73.4 per cent. and 73.9 per cent. in the Havana and Polish to 68.1 per cent. in the English and Beveren and 63.6 per cent. in the Rex. In contrast to this wide variation, no significant differences between the breeds were found for the neutrophiles per cmm. or for the monocytes, either per cmm. or in per cent. The Belgian, English, Polish, Beveren and Rex breeds had mean neutrophile levels of 3,760, 3,720, 3,750, 3,740 and 3,770 per cmm., respectively. Not only were typical blood formulae found for each breed, but closely related breeds, such as the Belgians and the English, and the Havana and the Dutch had similar blood formulae, and relatively unrelated breeds had widely different blood formulae. In addition, if the breeds were grouped according to weight, that is, heavy and light, their respective blood formulae were likewise grouped, the heavier breeds having significantly higher total white blood cells and higher basophiles and monocytes per cmm. and in per cent., and significantly lower hemoglobin and red blood cells than the smaller and lighter breeds. The animals of some breeds were entirely uniform for certain blood cell factors, while the animals of other breeds were heterogeneous for the same factors. In breeds where heterogeneity existed for a given factor the animals in which the factor was high were more closely related than those animals in which the factor was low and *vice versa*. It was concluded, therefore, that the differences in the blood formulae among normal rabbits are largely inherited differences and studies on the transmission of such characters are now being made.

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[1] P. Levine and K. Landsteiner, *Jour. Immunol.*, 17: 559, 1929.

[2] W. E. Castle and C. E. Keeler, *Proc. Nat. Acad. Sci.*, 19: 92, 1933.

BOOKS RECEIVED

The Comparative Life, Fire, and Explosion Hazards of Common Refrigerants. Pp. 118. Illustrated. National Board of Fire Underwriters.

HOLMES, HARRY N. *Out of the Test Tube.* Pp. x + 373. 83 figures. Long and Smith. $3.00.

KORDATZKI, W. *Taschenbuch der praktischen pH-Messung.* Pp. viii + 231. 65 figures. Rudolph Müller & Steinicke, München, Germany.

KUENEN, PH. H. *The Snellius-Expedition in the Eastern Part of the Netherlands East-Indies 1929–30. Vol. V: Geological Results; Part 2, Geology of Coral Reefs.* Pp. 125. 106 figures. Kemink en Zoon, Utrecht.

Report of the Librarian of Congress for the Fiscal Year Ending June 30, 1933. Pp. vi + 264. Illustrated. U. S. Government Printing Office. $0.75.